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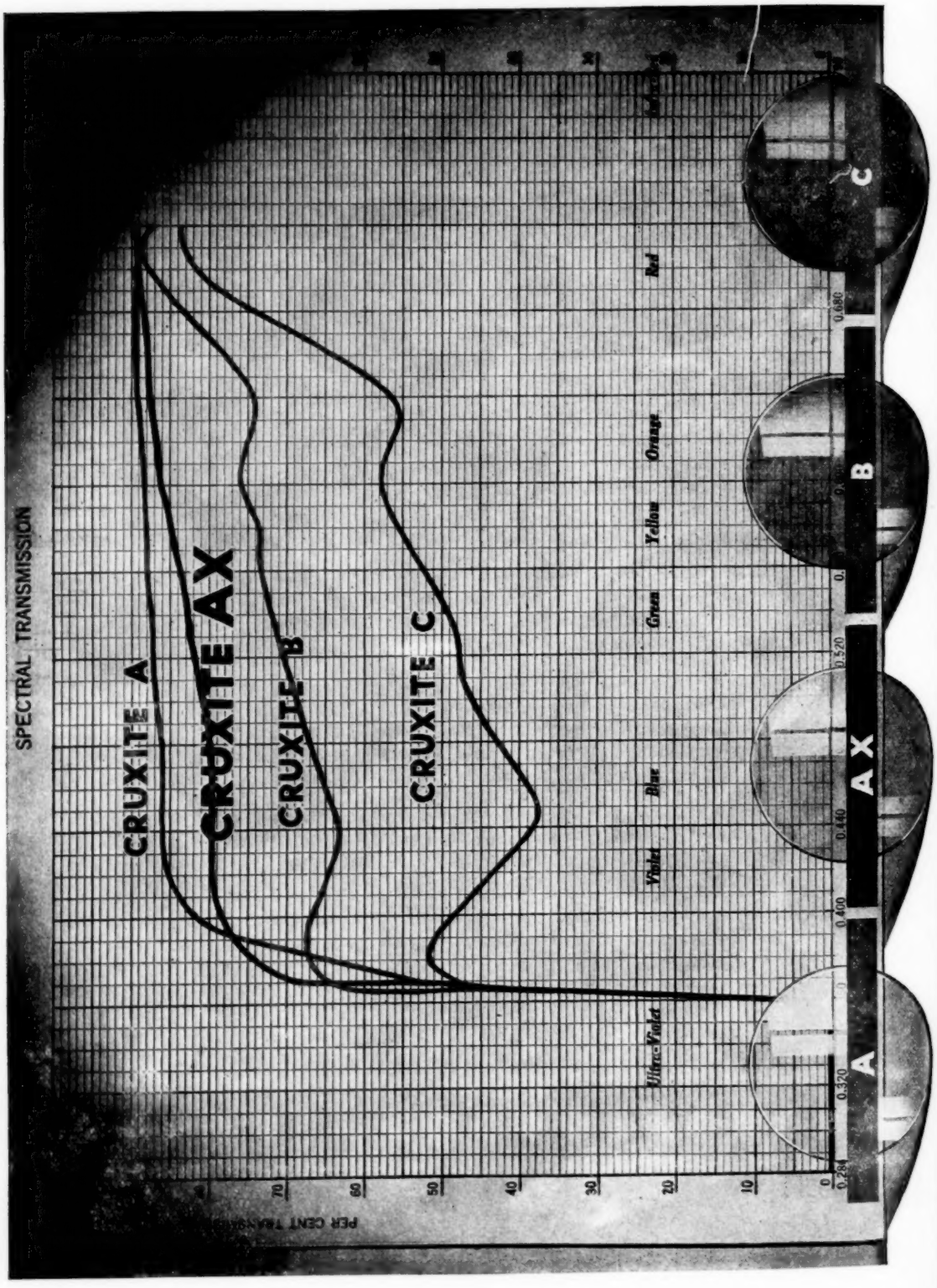

AMERICAN JOURNAL OF OPTOMETRY

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PRELIMINARY REPORT ON AN OPTOMETRIC SURVEY OF DELINQUENT CHILDREN AT THE CHICAGO PARENTAL SCHOOL*

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and
W. Jerome Heather, Opt. D., F. A. A. O.
Chicago, Illinois.

A criticism heard so frequently and so widely as to carry a strong presumption of truth is, that optometry lacks case data and case statistics on which to base any dependable conclusions affecting innumerable points of its practice. You may have heard this criticism expressed in the words, "Optometry involves too much theory," or "Optometric education is altogether too theorectical and not sufficiently practical." It is said that nearly every other science has a much larger proportion of demonstrated and demonstrable "laws" or "phenomena" than optometry, and that these laws facilitate procedures and prognoses.

Without subscribing in full to the various critiques directed against optometry on this ground, let us concede that our science does seem to have a plethora of theoretical knowledge and a dearth of empirical knowlege. The bulk of our practice is carried on, of course, by individuals. Tests and examinations vary from patient to patient. If records have been kept, rarely has any effort been made to integrate or analyze them. And one fact stands out in all of this, namely, that in each individual case, the patient is conscious of ocular discomfort or visual disability. That is why he visits the optometrist. Such patients, therefore, constitute a special category, and do not represent a fair cross section of the public.

It has been difficult to apply standard, uniform tests to a sufficiently large number of average people to produce any reliable mass of case data. An approach to this achievement is being made in the eye clinic of the Northern Illinois College[1], where we are applying uniform and very comprehensive tests to charity patients ranging in number from 80 to 100 a day. Detailed records are kept of these cases, the findings and the results. But here again we are dealing with

[1]Northern Illinois College of Optometry, 4043 Drexel Blvd., Chicago, Ill.

*An abridgement of the material presented before the American Academy of Optometry at Chicago, December 20, 1932.

that same special class of patients who are conscious of defective vision. It is true that school surveys have been made, and some interesting data has been gathered from these surveys. But we should like to point out that, in a majority of such surveys, the examinations have been largely superficial, and have not extended, of course, into psychopathic or pathological inquiries.

We have chosen for our report to the Academy, therefore, a survey of most unusual character which we had the good fortune to make last spring. This was an optometric survey of the 308 inmates of the Chicago Parental School for Delinquent Children. It required the services of eighteen examiners over a period of two weeks. Its primary and immediate purpose was to ascertain the oculo-refractive needs of the children examined, and to furnish them with glasses (see charts 1 and 2). As a secondary and more far-reaching objective, the survey was utilized to obtain contributory data for a study of possible relations between oculo-refractive errors and general biological and pathological defects—part of an extended research which is being conducted under the auspices of Northern Illinois College of Optometry.

The Chicago Parental School is under the general administration of the Board of Education: but it is directly administered by Superintendent Peter A. Mortenson, formerly superintendent of schools of Chicago. Our grateful acknowledgment is hereby made to Mr. Mortenson for the opportunity of making this survey, and for the splendid cooperation extended by him and his staff.

The age range of the inmates at the school is from 8 to 14 years. A large and competent staff of teachers carries on the instruction of these children while they are interned. They are committed for short terms by the Juvenile Court for offenses ranging from truancy and similar school offenses to petty theft.

Our preliminary report on the investigation of the group of 308 delinquent children examined is made for three reasons:

First—To furnish a general idea of the nature of the inquiry to which we have addressed ourselves.

Second—To set forth some facts emerging from this survey which it would seem must serve as "leads" in further investigations.

Third—To indicate the relation which the so-called delinquency factor has in an investigation of this character.

Scope of the Investigation.

Naturally, we were not able to give these children the detailed examination and the extended follow-up that we give to those who come to our own clinics; first, because we were limited in time and facilities, and second, because the children remain in the institution for only a few months, and then pass out of surveillance. The data obtained are restricted to existing conditions present in the children at the time of examination.

The investigation, aside from that of oculo-refractive errors, com-

prised inquiries into (*a*) general biological development; (*b*) visual defects other than actual pathology, and (*c*) general and ocular pathology.

General Biological Development

Systematic search was made in each case for physical and functional stigmata of developmental defectiveness, including the following:

Physical Stigmata:	Cephalic index
	Vertex index
	Asymmetry of face and head
	Darwinian ear
	Flecks in iris
	Irregular fundus pigmentation
	Cleft palate
	Club foot
Functional Stigmata:	Abnormal reaction to stimuli
	Abnormal emotional states
	Postural errors
	Lack of persistence
	Lateness in walking or talking
	Left or changed handedness
	Stammering
	Nocturnal enuresis
Mental Stigmata:	Intelligence quotient

The intelligence quotient was determined by a set of questions and tasks carefully prepared and designed to test, not the educational status of the child, but his or her native intelligence and alertness, graded according to age.

Visual Defects

These included nystagmus, color blindness, colobomata, fundus anomalies, photophobia and amblyopia.

Pathology

Inquiry was made as far as practicable into both the history and the present existence of diseased conditions, with special reference to acute and chronic infections, convulsions, nervous diseases, bad tonsils, sinuses and teeth.

Nationalities

No prearranged plan was observed in the selection of children for examination. We simply took them as they came, without order or selection, concluding the task when our allotted time was up. A tabulation of the nationalities represented in the group examined shows the following distribution:

Polish	75
Negro	70
Italian	49
Irish	29
German	15

Lithuanian	10
Greek	8
German-Irish	7
Slovakian	6
Jewish	6
Bohemian	7
Hungarian	3
French-Irish	3
Russian	3
American	2
English	2
Swedish	2
Irish-Swedish	2
Norwegian	1
German-American	1
German-Scottish	1
English-Italian	1
Scotch-Irish	1
Polish-German	1
Mexican	1
Serbian	1
Syrian	1
	308

The distribution is interesting, but no trustworthy scientific conclusions can be drawn from it. There are too many circumstantial factors to be reckoned with. The fact that the Polish, Negro, Italian and Irish races make up by far the largest proportion of the cases cannot be taken to indicate that these nationalities furnish the largest number of delinquents. But, while the distribution, *per se*, has no determinable significance, the tabulation of nationalities does enable us to evaluate the comparative incidence of the various defects among the different races, especially among those most numerously represented.

Oculo-Refractive Errors

There were only 22 cases of emmetropia in the entire group examined, which is a trifle over 7 per cent. Distributed as to nationality, and as to percentage of these nationals, they are as follows:

Polish	7	9	per	cent
Negro	3	4	"	"
Lithuanian	2	20	"	"
Slovakian	2	33	"	"
Swedish	2	100	"	"
Irish	1	3	"	"
Jewish	1	15	"	"
German	1	6	"	"
Italian	1	2	"	"
Bohemian	1	13	"	"
Irish-Swedish	1	100	"	"

With the exception of the four large groups mentioned above, namely, the Polish, Negro, Italian and Irish groups, not much can be deduced from this tabulation because the number of children examined in the other nationalities is too small. It is, however, interesting to note that the percentage of emmetropia in these four large groups is, in each case, exceedingly small. We shall discuss this aspect of the survey later.

The total number of children examined was 308. The tabulation into normals, biological defectives and pathologics gives the following figures:

Normal	206	67	per cent
Biologically defective	38	13	" "
Pathologics	58	18	" "
Biol. Defect. and Path.	6	2	" "

In a few of the cases it was impossible to get anything like a trustworthy refraction. The number and percentage of refractive conditions in the different groups run as follows:

Normals:			
Emmetropia	15	7.5	per cent
Hyperopia	75	37.5	" "
Myopia	8	4	" "
Hyp. Astig.	40	20	" "
Myo. Astig.	13	6	" "
Mixed Astig.	50	25	" "
Biological Defectives:			
Emmetropia	3	8.5	" "
Hyperopia	12	33	" "
Myopia	1	3	" "
Hyp. Astig.	11	30	" "
Myo. Astig.	3	8.5	" "
Mixed Astig.	6	17	" "
Pathologics:			
Emmetropia	3	5	" "
Hyperopia	21	37	" "
Myopia	0		
Hyp. Astig.	15	27	" "
Myo. Astig.	5	9	" "
Mixed Astig.	12	22	" "
Biologically Defective and Pathological:			
Emmetropia	0		
Hyperopia	2	33	" "
Myopia	0		
Hyp. Astig.	3	50	" "
Myo. Astig.	0		
Mixed Astig.	1	17	" "

From the standpoint of biological defectiveness, the cases must be tabulated rather differently. According to this classification, the cases which show pathology alone must be tabulated along with the biologically normal, while those that show both pathology and biological defects must be classed with the biologically defective. In this way, the tables show as follows:

Biologically Normal:	Emmetropia	18	7	per cent
	Hyperopia	86	36	" "
	Myopia	8	3	" "
	Hyp. Astig.	55	22	" "
	Myo. Astig.	18	7	" "
	Mixed Astig.	62	25	" "
Biologically Defective:	Emmetropia	3	7.2	per cent
	Hyperopia	14	33.3	" "
	Myopia	1	2	" "
	Hyp. Astig.	14	33.3	" "
	Myo. Astig.	3	7.2	" "
	Mixed Astig.	7	17	" "

It will be seen at once that the distribution of the various types of refractive error does not differ materially for the various groups. However, there is a still further revision of the tabulations to be made, in which hyperopic and myopic astigmatisms must be considered as connoting hyperopia and myopia respectively, since these forms of error, albeit combined with a non-uniform curvature of the cornea or lens (astigmatism), also indicate under-development and over-development of the eyeball respectively. In the following tables, therefore, the percentages of hyperopia and myopia will include the hyperopic and myopic astigmatisms rspectively, and the percentages of astigmatisms will include *all* astigmatisms, *i. e.*, hyperopic, myopic and mixed. This tabulation will give the percentages respectively of those showing short and long eyeballs, and those showing non-uniform curvatures.

Biologically Normal:	Hyperopia	141	50	per cent
	Myopia	26	10	" "
	Astigmatism	135	48	" "
Biologically Defective:	Hyperopia	28	70	" "
	Myopia	4	9	" "
	Astigmatism	24	65	" "

The outstanding feature of this revised tabulation is the marked plurality of hyperopic cases among the biologically defective over the biologically normal, a plurality of 20 per cent, and almost as marked a plurality of astigmatism, namely, 17 per cent.

The Cephalic Index

The tabulation shows that there are 101 children having a high cephalic index, which is practically 33 per cent of the entire number of children examined. Of these, 82 (practically 82 per cent) show no other biological stigmata, and 19 (practically 18 per cent) do mani-

fest other stigmata. Again, among these 101 high cephalic index cases, the refractive conditions are distributed as follows:

Emmetropia	5	4 per cent
Hyperopia	64	64 " "
Myopia	8	8 " "
Astigmatism	24	24 " "

Visual Defects

Visual defects other than actual pathology were strikingly few. There were only 13 cases of amblyopia, two cases of red-green blindness and one of combined amblyopia and red-green blindness in the entire number of 308 children examined. This being a trifle over 4 per cent. Eleven of the amblyopias were in the biologically normal group, two of them in the biologically abnormal group, and the combined case of amblyopia and red-green blindness was in this latter group. The two simple red-green blindnesses were in the normal group.

One of the amblyopic cases alone calls for special notice. It was in an Irish boy of 13 years of age, with a low compound hyperopic astigmatism who also had a corneal opacity in the amblyopic eye, which possibly accounts for the amblyopia.

The combined amblyopia and red-green blindness was in a Swedish boy of 15 years of age, with emmetropia who had a rather high cephalic index (.90) and stuttered.

Pathology

The cases showing actual pathology, numbering 64 in all, and constituting 20 per cent of the total, consisted mostly of infected tonsils and teeth, with a few cases of sinus infection. The tabulation is as follows:

Infected tonsils	37	58 per cent
Infected teeth	11	18 " "
Both of above	7	11 " "
Infected sinuses	6	10 " "
Furunculosis	1	1.5 " "
Epileptic fits	1	1.5 " "

As with the biological defectives, so with pathology, it can scarcely be said that the percentage among this supposedly delinquent group of children differs materially from that found among any group.

Heterophorias

Classification of heterophorias is for the present limited to conditions of tonicity as represented by orthophoria, esophoria and exophoria, respectively, at infinity, in associaton with hyperopia and myopia. In computing the percentages, simple and compound hyperopic astigmatisms are considered as hyperopia, and simple and compound myopic astigmatisms are considered as myopia. The percentages are approximate.

	Eso.	Exo.	Ortho.
Total:			
Hyperopes	58 per cent	18 per cent	20 per cent
Myopes	55 " "	15 " "	33 " "
Biologically Normal:			
Hyperopes	55 " "	20 " "	25 " "
Myopes	50 " "	30 " "	20 " "
Biologically Defective:			
Hyperopes	70 " "	8 " "	20 " "
Myopes	75 " "	25 " "	0 " "
Pathologics:			
Hyperopes	52 " "	28 " "	20 " "
Myopes	40 " "	0 " "	60 " "

Tonicities in cases of mixed astigmatism are not considered.

Discussion

The first thing that strikes us in the analysis furnished by the tables is the rather strikingly large percentage of normals, both as to biological development and as to pathology, in a group of supposedly delinquent children whose delinquency we are in the habit of attributing in large measure to physical and mental defectiveness. Indeed, a proportion of 67 per cent normals is about as large as one would expect to find in a similar number of children taken at random from any section of life.

This showing, from a sociological standpoint, has more than a mere negative significance. It does not simply indicate that a normal percentage of these so-called delinquent children had no physical or mental handicap. It points clearly to the more positive fact that whatever these children had done to cause them to be committed to the Parental School was the perfectly normal reaction to their living conditions, thus putting the responsibility for their delinquency squarely up to society as expressed in environment.

The conclusions to be drawn from the relationships between biological defectiveness and refractive errors are not as definite or outstanding as one might have anticipated. The facts are far from supporting the idea that hyperopia and myopia are always, or even in the majority of cases, to be found associated with stigmata of defective biological development. A plurality of 20 per cent hyperopes and 15 per cent astigmatics among the defective group over the normals is not sufficient to warrant any such broad generalization.

However, the data does, we think, throw some definite light upon the question of the general etiological relation between biological development and ocular refraction. The fact that the biologically defective group does show a plurality of hyperopia and astigmatism to as large an extent as 20 per cent and 15 per cent respectively would seem to indicate that the refractive status of the eye does, in some fashion, depend upon biological development. And the further fact, as shown by the data, that the plurality of refractive error in the biologically

defective group is all on the side of hyperopia (the vast majority of the compound astigmatisms being hyperopic) gives support to the belief that the normal process of development of the eye is from a state of hyperopia to one of emmetropia. This process, apparently, the ametrope most usually fails to achieve, leaving him hyperopic; and the more biologically defective he is, the less successful he is in achieving it. When the ocular development is faulty, it may or may not be attended with noticeable general stigmata; but the data show that where such general stigmata *are* in evidence, the association is more frequent.

Myopia, it appears—*i. e.*, over-development—is much less common as a biological defect than hyperopia, or under-development; indeed according to our tables, it occurs no more frequently in the biologically defective than in the normal. And this, of course, is precisely what we should expect if we postulate that the normal development of the eye is from hyperopia to emmetropia. It seems that we shall have to look for the causes of myopia in some other direction.

Among those children who show a high cephalic index, hyperopia is no more prevelant than among those with normal indices. Moreover, the percentages of the various refractive errors runs about the same in the high cephalic index group as in the total number examined, indicating that a high cephalic index has no relation, *per se*, to hyperopia, and justifying our decision to ignore this factor in tabulating our cases. Moreover, the fact that 82 per cent of the children with high cephalic indices showed no other biological stigmata would seem to indicate, further, that the cephalic index is not a factor in individual development, but must be regarded in some other light, possibly racial.

The refractive data on the pathological group does not lend color to the belief that systemic disease, at all events the kinds of disease included in our investigation, exercises any influence upon ocular refraction. No investigation was made in this survey of endocrine conditions because of lack of facilities. We are carrying out inquiries along this line in our college clinics, to be made the subject of a later report. But, so far as the diseases listed in our tabulations are concerned, they appear to have no relation whatever to refractive errors. The incidence of such errors in the pathological group does not differ materially from that in the normal group.

The incidence of astigmatism furnishes further presumptive evidence of the biological or developmental etiology of refractive errors, although from a rather different angle. Astigmatism runs, as we have seen, some 15 per cent higher in the biologically defective group than in the normal, with a plurality of hyperopic astigmatism. The inescapable inference is that a non-uniform curvature of the cornea or lens is an incidental non-uniformity in the development of the eyeball, most commonly associated (when compound) with the commonest axial defect, namely hyperopia. In passing, it may be remarked that from this developmental standpoint the so-called "mixed" astigmatisms should be differentiated according to the curvature element which pre-

dominates. If the two elements are about equal, no under- or over-development need be predicated; but if the hyperopic or myopic element is markedly in excess, we may suspect under- or over-development in association with the non-uniformity.

Lastly, in this matter of refractive conditions, it is to be noted that the total percentage of refractive errors in the entire group examined is very high, in fact much higher than has been shown to prevail among people in general. It is usually estimated, by repeated surveys, that about 60 per cent of people at large have refractive errors. In this entire group, the proportion is 93 per cent. Whether any trustworthy conclusions can be drawn from this as to the relation between refractive errors and delinquency we do not undertake to say. However, we are confronted by these three significant facts:

First—That this is a delinquent group.

Second—That the group shows, outside of refractive errors, no larger percentage of defective stigmata than any group taken at random.

Third—That it does show a percentage of refractive errors more than 35 per cent higher than the general percentage.

On the face of it, one can hardly escape the suspicion that the refractive errors do have some sort of relation to the delinquency.

Heterophorias

Analysis of the heterophorias from the standpoint of tonicity shows that the total number of esophores and exophores, respectively, does not materially differ as between hyperopes and myopes; the hyperopes have a trifle the majority of both. Orthophoria is quite noticeably more prevalent among the myopes.

Among the biologically normal group the percentage of orthophoria and heterophoria does not materially differ from that of the whole. Esophoria is somewhat higher among the hyperopes, and exophoria rather higher among the myopes. Orthophoria is somewhat more prevalent among the hyperopes than among the myopes.

In the biologically defective group, esophoria is considerably higher than in the whole group, and than in any other group. Moreover, esophoria is somewhat higher among the myopes than in the hyperopes. Exophoria, in this group, is exceedingly low among the hyperopes, less than one per cent, and fairly high (25 per cent) among the myopes. Orthophoria is the same among the hyperopes as in the normal group, but is altogether lacking among the myopes.

In the pathological group, esophoria is fairly high among both hyperopes and myopes, the former having the larger percentage. Esophoria among hyperopes is considerably higher than in any other group, or in the whole, and is absent among myopes. Again, the percentage of orthophoria among the hyperopes is the same as in other groups, while among the myopes it reaches the high proportion of 60 per cent.

The general conclusion to be derived from this analysis is that our ancient assumption of a causal relation between hyperopia and esophoria, and between myopia and exophoria, is untenable, since in the total group the percentages of esophoria and exophoria are substantially the same among hyperopes and myopes. Evidently the refractive error is not, of itself, the determining factor in producing one or the other kind of imbalance. Some other determining factor must be sought, the clue to which may perhaps be found in a comparison between the normal and abnormal groups.

Leaving the pathological group out of consideration for the present, it appears that under normal biological conditions, the hyperope and the myope evince about equal ability to maintain orthophoria. Under abnormal conditions, however, the difference between them in this respect is striking, the hyperope displaying about the same ability as in normal conditions, while the myope breaks down utterly. Further, it appears that under biological defects both hyperope and myope show a marked increase of tendency toward esophoria rather than exophoria. In the hyperope, this tendency is overwhelming, exophoria being less than one per cent; and in the myope while not quite so overwhelming, it is sufficiently striking, the proportion of esophoria to exophoria being 3 to 1 as against 1.66 to 1 in the normal group.

Can anything be deduced from these comparative data?

If we accept the physiological premises (*a*) that the internal recti are the positive muscles in the fusion coordinating group, *i. e.*, the muscles which are positively innervated by the brain, and (*b*) that these muscles, as distinct from the externals, are hypertonic at birth, in common with all the flexor muscles, their tonus being ultimately inhibited by the developing brain; and if we further accept the view that coordination defects are not, in the last analysis, the direct consequences of refractive errors (else all ametropes would have them), but the reactions of handicapped muscles to such errors, then the data obtained from this survey begin to make sense.

In the first place, we should expect esophoria to predominate in both types of refractive error and under all biological conditions, normal or abnormal. That is to say, we should expect the internal recti to be the most subject to spasticities, hypertonus and tetanus, since they are the muscles with which hyperope and myope alike actively manipulate their coordination. And this is what the data show to be the case. On the other hand, when biological conditions are normal we should expect the percentage of hypertonus or tetanus to be somewhat higher in the internals among hyperopes than among myopes, since (*a*) the hyperope has a greater tension in these muscles than the myope, and (*b*) the elongated eye of the myope is harder to manipulate inward than the short eye of the hyperope. Nevertheless, apparently, the positive activity of the internals outweighs these other factors in the majority of cases in both hyperopes and myopes.

When biological conditions are not normal, we should again ex-

pect the positive activation of the internals to exercise a still more predominating influence in the production of imbalances, and the percentage of esophoria to be markedly higher, both in hyperopes and in myopes, particularly in hyperopes. And this, again, the data show to be the case. Practically all of these biologically defective children evinced stigmata indicative of neuro-muscular spasm (enuresis, stuttering, etc.) which in the hyperopes would inevitably produce an almost 100 per cent proportion of esophoria, and in the myopes would just as inevitably produce at least a 2 to 1 predominance of internal recti spasm over the factors tending toward exophoria.

In the matter of maintaining orthophoria, the data show that under normal biological conditions the ability to do so is about equal as between hyperopes and myopes, with the advantage a little on the side of the hyperopes, whereas under abnormal biological conditions the abality of the hyperopes suffers a little decrease while that of the myopes breaks down badly. (Our figures show it to be zero, but of course a larger number of cases would probably give some small actual percentage.) Whatever the actual comparison, it is evident that under abnormal conditions the hyperope displays a much greater ability to maintain orthophoria than the myope.

How does this consort with our physiological premises?

At first, it must be admitted, not so consistently, since the internal recti are the positively activated muscles, and the myope, at infinity, does not have to exercise these muscles, it would seem that he would be in a better position, under all conditions, to maintain orthophoria. It must be borne in mind, however, that biologic defects constitute general types of individuals, of which the over-developed type commonly associated with myopia is always a more neurotic one than the under-developed type usually associated with hyperopia. Inhibition is, after all, the means by which orthophoria is maintained; and inhibition, as a rule, is precisely what these over-developed biologic types most conspicuously lack.

The pathological group for the present admit of no trustworthy analyses or conclusions. The number of cases examined was too few. Especially the number of myopes was too few for comparison; there were only five in this group. We shall defer analysis of pathological cases until some future time.

The whole subject of phorias, as revealed by this survey, needs much further study, for which considerable time and a larger number of cases are required. For the present, the conclusions from the survey may be limited to the following:

Summary

We may summarize the results of the survey in the following statements, some of which, as will be seen, represent definite conclusions, while others merely express investigational findings and their probable implications:

1. The percentage of biological defects among this delinquent group is no higher than is to be found among any group of children taken at random.

2. The refractive status of the eye does apparently have some relation to the biological development.

3. The plurality of hyperopia in the defective group supports the belief that the normal development of the eye is from a state of hyperopia to one of emmetropia, which the under-developed child falls short of achieving.

4. Myopia, a stigma of over-development, is much less common than hyperopia, still further supporting the implication of paragraph 3 and making it highly probable that the causes of myopia will have to be sought in other directions.

5. Systemic pathology and focal infections apparently have no influence in the production of refractive errors.

6. The incidence of astigmatism furnishes further presumptive evidence of the developmental etiology of refractive errors, being a non-uniform development of the eyeball most commonly associated with the commonest axial defect, namely—hyperopia.

7. The high percentage of refractive errors (93 per cent) indicates that refractive errors have some relation to delinquency.

8. Refractive error is not, of itself, the determining factor in the kind or degree of heterophoria, although it has a bearing on it.

9. Heterophoria is the result of tetanic or refractory reactions of the neuro-musculature, of which tetanus of the internal recti, producing esophoria, is the most frequent, both in hyperopes and in myopes.

10. Under normal biological conditions, hyperopes and myopes apparently have equal ability to maintain orthophoria, with the advantage a little on the side of the hyperope.

11. Under abnormal biological conditions, myopes manifest very poor ability to maintain orthophoria, probably because of the neurotic qualities of their biological type.

12. None of the data lends any color to the mechano-mathematical interpretations of muscle imbalance which so commonly prevail, but point unmistakably to the physiological, pathological and pschyological nature of these incoordinations.

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OPTICAL CONTROL OF THE CENTRAL GRAY*

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Following a lecture given by the writer eight years ago, a member of the audience asked permission to amplify some of my remarks. Permission being granted, he approached the front and made three statements of fact which have been the guiding posts for further investigation along the lines of this paper. This speaker said that three primary factors governed the biological end-result in any given set of circumstances and he named these factors to be: a. Heredity, b. Environment, and c. Reaction to environment.

It is obvious to the hearer that if at any time he approaches a living organism for the purpose of influencing it functionally its heredity is fixed at the time the approach is made. This factor can not be changed. The environment may vary through all stages of heat, cold, light, electrical tension, physical contact, force awkwardly applied, food intake and any number of the other environmental conditions which are more or less constantly changing. How the individual will react to these changes is obviously determined by his hereditary make-up and the type of environmental change, particularly the suddenness with which the change is made, or the extremes to which the change may go.

Heredity remaining the same, the *tendency* of the reaction to environment is most likely to be governed by the suddenness or the intensity of the change in environment, constantly keeping in mind that environmental changes should remain well within the limits of the normal environment in which the organism evolved. Fish live in water, not on dry land. Horses live on land, not under the sea. To subject either of these to the environment of the other would result in death. Hence, the statement that the environmental change must be within the biological limits of the evolution of the animal. Furthermore, it might be said that to produce most beneficial effects the change in environment should be made in those environmental conditions which are most constantly present during the life of the animal. Since we are dealing

*An abridgement of the material presented before the American Academy of Optometry at Chicago, December 20, 1932.

with human beings we might enumerate heat, light, food and shelter as perhaps the most universally present environmental factors. Of course, in dealing with human beings we also have certain mental or emotional states, either of which may, to some extent, alter function, but largely through the agencies of physiological reactions.

Heredity, to a large extent, determines the type and kind of physiologic and anatomic structure with which the animal is endowed. Also, heredity determines the weak qualities and the strong qualities of the individual in terms of structure, and functions which may be attributed to structure. Like Gaul, all humanity may roughly be divided into three parts. The heredity of the individual largely determines into which of these three divisions he will fall. One of the divisions might, for the purpose of discussion, be pointed out as being that in which there is a strong vital system which will, to a large extent, determine the size and shape of the individual and the quality of his biologically active functions. A second class would be of those in which the restrainers of biologic functions are the most active, characterized usually by a deficiency of biologic activity and a relatively low grade of physical development accompanied by a relatively high grade state of mental and nervous function. The third class would be a group in which the two foregoing states are evenly balanced, characterized largely by a median grade of biologic and functional ability.

The criteria by means of which the differentiation into these classes are made have been adequately studied and set forth by *Daniels, Gonzalees, Bean, Sigaud* and others, and are too lengthy and involved for inclusion in this paper. With reference to the antagonism existing between these two main systems, *Kempf, Dana* and others have undoubtedly done monumental work in classification and the study of functional effects of this never ending conflict between the biologic drive and the antagonistic physiologic functions.

In view of the foregoing, it can readily be seen that the reaction to environmental changes of the three main groups will be and is conditioned by the state of tension of the dominant hereditary characteristics of the individual. Heretofore, in Optometry we have taken into consideration only the psychological effect of the application of geometric optics such as to make what *we believe* to be "perfect pictures" on the retinae, hoping that the patient's brain would accept *our* concept of these pictures as the correct one. We have miserably failed to keep constantly in mind that *our* concept of these "perfect pictures" is determined for us by our own heredity, our own environment and our own reactions to our environment. Obviously, all three of these conditions are widely different in the case of the patients in our ophthalmic chairs. We have sought to establish a preconceived normal. We have forgotten that "normal" is a variable term and varies with each individual, even as it varies between two eyes in the same head as shown by *Peckham, McFadden* and others in optometric research circles. Furthermore, during our work with geometric optics we have wholly ignored another

most potent factor, and that is what I have neologized in my former report, the "power factor" of light—the energy component.

Thompson, Russell and *Knowlton* have reported and done considerable research in the field of "work optics." *Bohr* and *DeBroglie* have mathematically determined certain factors with reference to not only emission of light but its work doing power. These men have shown that the power of light to do work[1] varies with its frequency in terms of factors given in a former paper, read before this Academy, to which you are referred.

Since the quantity of electrons released by light quanta is determined by the frequency of the incident light it naturally follows that the state of electrical charge which remains on the object irradiated has the potential of its polarity charge largely determined by the frequency of the incident light. Since electrons carry negative charges and are released by incident light of the higher frequencies, the remaining charge obviously is a positive charge or a state of positive ionization. In the retina and choroid ionization is constantly taking place even with the eyes closed. This ionization is greatly increased during the waking state under the influence of incident light. The writer believes that ionization takes place much more readily in the perimacular area and the peripheral portions of the retinal fields than it does in the macular area. This belief is based on a study of physiologic reactions experimentally produced by keeping the macular area in shadow during the irradiation of the retina with varying frequencies of light in the so-called visible range.

It may be argued that whereas various frequencies of light may be capable of ionizing matter in the laboratory that such ionization does not necessarily take place in living biologicals. The writer believes that the work of *Sperti* conclusively proves that certain selected frequencies of light are capable of "knocking electrons out of atoms," even though the atoms be a part of a bit of living protoplasm. We believe we are treading on scientific ground when we assert that light entering the eye increases the rate of ionization and ionization is a distorted state of electrical charge.

The researches of *Adrian* in the electrical character of living processes, those of *d'Arsonval* and of *Telkes*, all support the thought that light striking the retina, results in the setting up of a difference of electrical status, with the result that electrical impulses follow afferent paths to the brain and visual centers, as well as to the centers controlling the associated and supportive functions of vision.

In an effort to explain "synaptic discharges," *Pasque* likens the synapse to an electrical condenser which, if a charge be placed on one conductor of the condenser will result in the establishment of an opposite charge on the other conductor of the same condenser. One result of this explanation is that if an even number of synapses occur in a neural

[1]H. Riley Spitler. Optical Control of the Central Gray. American Journal of Optometry, Vol. 9, pp. 403-411.

pathway that the charges at the extremes will be identical, while if an odd number of synapses are in the neural path the charges at the extremes will be opposites. This explanation of *Pasque's* seems to fit the facts as they exist in the synaptic relationships in the retina between the rods, cones, efferent and afferent pathways, and certain reactions that are known to take place under the influence of selected light frequency bands.

The rate of discharge of a condenser depends on several factors, two of which are the resistance in the circuit and the "gap," which itself is a form of resistance. To discharge a condenser with a high resistance in the circuit requires an increase in potential and we have already shown that as a result of the ionization the potential increase is determined largely by the frequency of the incident light, which, therefore, determines the rate of discharge. It is interesting to note in this connection that *Max Coque* states that the rods and cones shorten under the influence of light. If the foregoing thoughts by *Pasque* in anywise fit the facts, this shortening of the rods and cones under the influence of light will require an increase in potential to set up a synaptic discharge in the form of afferent impulses, this because of the increased resistance in the "gap."

The "power factor" in light for the purposes under discussion may be applied in two ways: One, to some extent, by control of luminosity, and the other by control of frequency. Control of frequency, however, introduces the factor of periodicity, which it seems, has some definite connection between the rate of synaptic discharge or reflexes set up by these discharges. The end result effect is primarily in those functions associated with and supportive of vision.

Kurtz, in his writings, has often referred to the work of *Crile* and the difference in electrical potential existing between the liver and the brain, the positive charge being in the brain and the negative charge at the point of greatest chemical activity—in the liver. *Telkes* has shown that the very life of the animal is to a large extent dependent upon the maintenance of a difference in electrical potential between the central nervous system and the rest of the body. By means of the utilization of the "power factor" we have found that it is possible to alter, within reasonable limits, the existing difference in potential, to the end that biological functions as they pertain to the visual apparatus may be increased or decreased within the limits of reasonable control. It is our opinion that the efferent paths to the eyes have something to do with the maintenance of this potential difference. It is very difficult to prove this in the laboratory, and to a large extent we are compelled to rely upon clinical evidence, which at best is more or less unsatisfactory.

Even if the line of reasoning suggested above cannot be proved in the laboratory because of the difficulties of dealing with the living brain and eye in this connection, and even admitting the possibility that the approach to the subject is not altogether conditioned upon a potential difference, there remains the further fact that the affective states can be

and are to a large extent controlled within the central gray and that the eyes and their nervous connections in the central gray are the most direct approach to this mass of gray matter. Such authors as *Morris, Dana, Cannon, Villiger, Kuntz* and others are uniform in their assignment to this central gray of those nervous functions, ganglionic in nature, which control certain supportive functions of vision which, we, as optometrists, must study and take into consideration in the treatment of light before it enters human eyes in our efforts to aid and improve vision. This control largely takes the form of maintenance of a practical balance between the tensions and antagomisms normally existing between the biologically active and the antagonistic mechanisms, discussed earlier in this paper in their relationship to the physical types of hereditary origin.

While it is true that many of the associated and supportive functions of vision, having their control in the central gray, are fairly definitely localized, the fact remains that much of the control exercised over these functions by the central gray is "pattern action." In other words, these actions when effective take certain definite forms and call for certain reactions always in the same way as a result of the same stimulus. Whether these actions are brought forth by energy waves traveling through the mass of nerve cells with their attendant additive and subtractive resultants as hypothecated by *Lashley*, or whether the action is the result of synaptic discharge from cell to cell is of no great importance in this discussion, because the fact remains that the action takes place precipitately, powerfully and completely in the *absence* of cortical control, in fact, *despite* cortical control.

Optometrists deal largely with departures from normal, both anatomical and functional, and as *Melvin* so aptly said yesterday, "Optometry is a highly specialized branch of neurology and we must learn to see it in this light." The use of the "power factor" in light is of little avail in purely anatomical departures from normal but it surely is our most effective approach to those departures from normal which are functional in character, whether they be associated with or supportive of vision.

Another fact, which we as optometrists must learn to apply more intelligently, is that all corrective energy applications are more potent in their effect during departures from normal than they are under so-called normal conditions. The tendency of all biological processes is to run a certain normal course or cycle. A departure from this course is against the stress of the biological tendency back toward normal. To illustrate, if a prism, base-in, be placed before an eye, the eye turns out just enough to maintain simultaneous single binocular vision, if the prism be of relatively low power and can be fused. Under the condition of this experiment the eye is in an *enforced state of departure from normal*. The tendency of the eye behind the prism is to turn toward the nose, it is in a state of esophoria, because the normal, from the enforced position behind the prism, is an inward turn of the eye. Obviously, it will require

a very slight stimulus or the mere removal of the prism to permit this esophoria to return the eye to its proper normal. Do not lose sight of the fact, then, that the tendency of departures from normal is toward the normal, and more often than not a very slight stimulus in the proper direction will result in the re-establishment of that normal. Such is the biological tendency.

Anatomical departures from normal are not thus easily normalized. They tend to persist and their responses to stimuli are practically zero. Modern optometry deals more and more with functional abnormalities rather than with anatomical abnormalities. This shows a healthy developmentment of the art.

On the other hand the utilization of selected light frequencies, in many cases, supplies the needed stimulus to enable a functional departure to return to normal. Obviously, the effects of the stimulus are temporary. They would not dare be otherwise. The effects of drugs applied in medicine are only temporary, and usually only last from about three to five hours. The hope is always that under the stimulus of the drug, or the rest given by it, the disease process may succumb to the defensive forces of the body. While optometrists are not concerned with pathology in any way, the fact remains that there is a large number of functional departures from normal of the associated and supportive functions of vision which only require a proper light stimulus repeated often enough to result in re-establishment of the normal relationships of vision, with a consequent disappearance of many distressing symptoms of ocular origin. These results are obtainable by staying well within physiological limits, and by the utilization of that energy which the eye is peculiarly adapted to receive and to relay to the central gray and cortical centers.

In this connection it seems only right that mention should be made of a physiological status as it pertains to the vasomotor mechanism. During the lifetime the normal condition is one of relative vasoconstriction, except when the parts supplied by the blood vessels are in a state of physiologic activity or being irritated. Many conditions which result in symptoms referable to the eye may be attended by vasodilation as a result of irritation by some ocular functional departure from normal. Such a vasodilation is purely physiological, and only requires that the excessive activity be decreased or compensated for, or that the source of irritation be removed or its effect destroyed. Satisfaction of either of these conditions will result in the return of physiologic vasoconstriction.

This physiologic reaction may easily be demonstrated by pressing the tips of the fingers of one hand on the other bared forearm for about two minutes. Immediately upon removal of the pressure of the fingertips the observer will notice a compression anemia, which will shortly give way to hyperemia. This hyperemia is the result of inhibition of the vasoconstrictors or stimulation of the vasodilators, presumptively, the former. The spots of hyperemia will remain only so long as it takes the normal vasoconstrictor action to resume control of the caliber of the

blood vessels. A hyperemia under these conditions is *not* inflammation nor is it pathological. Its tendency is back toward the normal vasoconstriction to which condition it will shortly return. This little experiment is a further illustration of the tendency of departures from normal to return to normal as soon as the disturbing stimulus is removed. Therefore, we should keep in mind constantly that in the application of the principles herein discussed we are always staying well within physiologic limitations, and that those departures from normal which tend toward normal will quite likely return to normal by the proper treatment of light before it enters the eye, either by the application of geometric or energy optics, or a proper combination of both methods.

The writer realizes that conclusions drawn from the clinic, seldom are accepted as final, yet he is constrained to remind the hearer that clinical evidence must be looked upon as supportive evidence until such time as researches can be instituted looking to further establishment of the principles under discussion. With these thoughts he craves your indulgence in the following case reports:

No. 1. Master O: Type A; age 12; weight 100; sex, male; very nervous child with normal V. A., in right eye, but with amblyopia with only 20/200 vision in the left eye.

His correction was:

O. D. +1.00 D. Sph.
O. S. +2.50 D. Sph. ⊃ +1.00 D. Cyl. axis 90.

This had been worn with no gain in vision of left eye. Nascentized[1] alternately L and NL.

8 sessions $\mu\theta$ for 12 minutes
4 sessions $\delta\omega$ for 12 minutes
4 sessions $\alpha\delta$ for 12 minutes

Vision in left eye improved to 20/25 with same lens prescription.

C.

No. 2. Master S. Type near P; sex, male; age 10; with history of inability to see to do school work. School doctor informed parents that boy was going blind. Had never worn glasses and had vision of 10/100 O. U.

Skiascopy showed about +.50 D. Sph. O. U. with no improvement in vision. Thought boy might be maligner. Nascentized L; syntonized $\alpha\delta$ for ten minutes. To surprise of both parents and self read 20/30 O. U. at the end of the period. After five sessions read 20/15 O. U. No glasses prescribed.

K.

No. 3. Mrs. K. Type M; age 66; patient had had cataract operation some time ago which, with correcting lenses, gave V. A. of

[1]Nascentizing is that process of using differing frequencies before the two eyes to disrupt existing reflex status before syntonizing. Nascentizing differs with source of ocular condition whether local or non-local. L equals local; NL equals non-local. The term syntonize means the use of selected frequency with or without interruption or fixation object.

15/20 +. Patient complains of intolerable and persistent vertigo while wearing lenses, sometimes rising to feet will bring on a spell. Nascentized NL; syntonized ω for 20 minutes for four sessions. Vertigo has disappeared and is comfortable with glasses.

K. O.

No. 4. Patient, Miss B; Type P; age 11; N. V. 20/50 O. U. and singly.

Rx —.50 D. Cyl. axis 180 O. U., with no improvement in vision. Made field chart for form and color. All color fields contracted, particularly the green. Indirect field for form seems gone. Nascentized NL; syntonized $\mu\delta$ and $\mu\theta$ and after eight sessions over a fourteen day period she shows expansion of all fields to a practical normal and shows normal V. A. with lenses mentioned above.

H.

No. 5. Mrs. C. G.; age 52; with fully matured cataract O. D., but had a crescent shaped opacity over lower portion of O. S.

Patient explained that local oculist had been treating O. D. for some time. She then noticed vision was blurring in O. S., and physician explained that everything had been done that medical science knew, but would concentrate on O. S. to delay development if possible. The last resort was held out as an ultimate operation.

Patient was then persuaded to consult me. O. S. best vision was 20/200. Nascentized L; syntonized μv. After three months of syntonization left eye had 20/30 vision with no opacity observable.

W.

No. 6. Mrs. M; Type A; age 38; continuous top-head headaches which lenses did not relieve. Conjunctiva, normal; media, clear; fundus, normal.

Her correction was: O. D. +.50 D. Sph.
O. S. +.50 D. Cyl. axis 90.

Nascentized NL; syntonized αv daily for six days, 15 minutes to a sitting. Patient only had ONE headache after starting with syntonics.

Later report: One year later. Patient has gained 30 pounds and had not had a headache since she was discharged.

E. E.

No. 7. Mrs. W.; age 65; complained of poor vision. Examination revealed well advanced cortical cataracts.

Uncorrected V. A. O. D. 20/200.
O. S. 20/120.

With her best correction: V. A. O. D. 20/100.
O. S. 20/ 90.

Nascentized L; syntonized μv on alternate days for 27 days and opacities reduced about $\frac{1}{3}$, and density seemed less. Continued syntonics for 30 more days with same prescription, when with same lenses used above: O. U. +1.75 D. Sph. Reading add O. U. +2.25 D. Sph. She

had V. A. 20/20 O. U. and singly. There is still a slight punctage appearance in lower portion of place where opacity was originally, but these do not seem to interfere with either distance or near vision, she being able to read agate type under usual home conditions.

J.

No. 8. Miss R: Type P: age 50: occupation, teacher; case referred by Dr. S.: this is case of myopia which has been progressing, requiring gradual increases of minus lenses. Last refraction by physician indicated the need for O. U. —22.00 D. Sph. V. A. 20/80 faintly. Myopia was so great that it was impossible to see the fundus with ophthalmoscope. Because of increasing dimming of vision patient was desperate and feared approaching blindness and loss of position. Nascentized L: syntonized μv, beginning February 14, 1931. Sessions were held two and three times weekly with gradually improving vision. Began reducing minus power as vision improved.

On June 20, 1931, her correction was O. U. —16.00 D. Sph. with V. A., best 20/35, but this varies slightly at times.

Note: Minus power reduced 6.00 D. and acuity greatly improved. She was enabled to hold her teaching position.

J.

No. 9. Mrs. B.: type A: age 37; regular occipital headaches with recurrent pain in O. D.: pupils react sluggishly to light: conjunctiva yellowish pink: media clear: had been given eye-wash at hospital for pain in O. D. Her correction was O. D. +1.75 D. Sph. O. S. +2.00 D. Sph., but headache and pain in right eye not relieved. Nascentized L: syntonized μv for three sessions, and then alternated μv and $\mu\delta$. Sessions every other day. Patient dismissed at end of two weeks feeling fine. No discomfort with same correction.

Q.

The Greek letters used above refer to laboratory designations of syntonizing equipment.

The attention of readers is directed to the fact that each of the above case reports has been sent to the writer of this paper by optometrists who use, in their offices, the technique developed by the speaker, and built around the principles set forth in his former and the present paper. By refraining from reporting his own cases the speaker has endeavored to show that by proper application of the principles involved it is possible for any optometrist, qualified therein, to do the things necessary to aid the associated and supportive functions of vision by proper treatment of the light before it enters the eyes of the patient.

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AMBLYOPIC TREATMENT TECHNICS*

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For purposes of discussion this paper will confine itself to amblyopia ex anopsia. This type of amblyopia is strictly an optometric problem. There are two general types of amblyopia ex anopsia (hereafter referred to as simply amblyopia). We find those cases where the cortical connections were never developed and the eye has never enjoyed good vision. We also know the second type where good vision may have been developed but where, because of some difficulty, perhaps a high refractive error, a marked degree of imbalance or injury, one eye has been ignored and because of non-use, amblyopia has resulted. Corrective methods must pursue the same course for both these cases.

Any treatment to be successful must first create a *desire* to see and the ways devised to create this desire are many and varied.

When I was invited to present this paper before the Academy, I discovered that I had been given a subject which was at one and the same time as easy an assignment and as difficult a one as I could have been given. A very difficult one, for the reason that almost nothing has been written on the subject and I found no comprehensive sources of information from which to obtain the conclusions of others' efforts and from which I might benefit, but for the same reason the subject was an easy assignment, because my audience had no more sources of information than I, and in all probability were no more informed on this subject. I believe that more on amblyopia has been written by Peckham in "Squints and Heterophorias" than by all other writers combined and I commend his volume to you.

In this paper, I have studiously avoided presenting a dry discussion of sensory neurons, synapses and brain patterns. I have tried to treat only of practical means for the correction of amblyopia, which are applicable by the practicing optometrist in the average equipped office.

Most text books dismiss amblyopia ex anopsia with a mere mention and with the simple suggestion that the better eye be bandaged or otherwise occluded, possibly by the long continued use of atropine as

*An abridgement of the material presented before the American Academy of Optometry at Chicago, December 19, 1932.

an encouragement for the amblyopic eye to resume operation. We all know that in the vast majority of cases these techniques are totally ineffectual and worse because they consume time which might have been well used to better advantage.

I know of no simpler way to outline my methods of dealing with this problem than to present two typical case reports and to give step by step the procedure and the results obtained.

CASE NO. 1

Walter A., age 27, office worker, consulted me wearing O. U. + 3.00 Sph.

Right convergent strabismus of 5 mm.
Visual acuity O. D. with "correction," doubtful light perception.
Visual acuity O. S. with "correction," 1.00%=(20/20).

Gave history of being "blind in right eye always, and that several oculists had told him that nothing could be done for his right eye except an operation which would make it look better but would not help his sight."

Motility of both eyes normal.
Ophthalmoscopic picture both eyes normal.
Ophthalmometer reading O. U. + 1.00 × 90.
Skiascopic finding O. U. + 4.00 D. Sph. ⌒ + 0.50 D. Cyl. axis 90.
Visual acuity with Rx O. D. doubtful light perception.
O. S. 1.00 D. Sph. (20/20).
Right convergent strabismus 5 mm.
Pupillary reaction to strong light stimulus
O. D. very sluggish,
O. S. normal.
Treatment instituted:

O. S. totally occluded and O. D. subjected to a focused light of sufficient strength to obtain positive information from patient that he "was sure light was lit." In his case, it required a light of 200 watts, placed ten inches before the patient with a condensing lens of 20 D., interposed at a distance of 2 inches from his eye. This light was connected with a flashing device and was timed to flash on and off at a speed which would allow a full contraction of the iris on each flash and a full relaxation between flashes. At first treatment, this was but 15 flashes per minute. Time of first treatment twenty minutes. Second treatment following day. Same technique, except that 100 watt bulb was sufficient to allow patient to be positive of sensation of light and to be able to detect changes in color. Pupillary reaction quickened so that 25 flashes per minute could be given.

Third treatment following day. 25 watt light could be detected with 30 flashes per minute.

Fourth treatment, two days later. Patient reported being "able to tell time on his wrist-watch."

Visual acuity O. D. 30%. O. S. 100%.

Treatments changed to a revolving disc made up for this occasion and which Peckham describes on page 114 of "Squints and Heterophorias," which I quote,—"Pine uses a rapidly whirling disc of white cardboard on which are mounted four or five lozenge shaped areas of red tinfoil, glued to the card, not smoothly, but puckered up into cones, ridges and grooves, irregularly raised surfaces that catch and reflect the light, giving scintillating, ever changing radiations as the disc whirls. This is a most powerful, effective stimulant to dormant visual neurons. When thus awakened, the case is finished with the kratometer or other methods."

After two such treatments given with the left or good eye occluded, the bandage was removed and there was substituted a ruby filter before the left eye and it was discovered that the patient had binocular vision but diplopia. I gave sufficient base-out prism to obtain fusion, these to be worn during treatments only.

Visual acuity after six such treatments:

O. D. 60%.
O. S. 100%.

He still had a right esotropia of 2 mm.

Patient then changed to Cameron's Myologic Unit where prescribed technique was followed.

Following ten such training periods—

Visual acuity: O. D. 100% with orthophoria and stereopsis.
O. S. 100%.

Case dismissed.

CASE NO. 2

Stanley C. Age 8½ years, school child.

History on this case was unattainable, as the child was an orphan recently adopted. He had a right exotropia of 8 mm.

Visual acuity, O. D. no measurable amount ("blind").
O. S. 120%.

Motility both eyes normal.

Ophthalmoscopic picture normal.

Ophthalmometer reading:

O. D. $+150 \times 95$.
O. S. $+ 0.75 \times 85$.

Skiascopic finding:

O. D. + 1.50 D. Sph. $\bigcirc$ + 0.75 D. Cyl. axis 95.
O. S. + 1.00 D. Sph. $\bigcirc$ + 0.25 D. Cyl. axis 85.

Visual acuity with Rx:

O. D. no measureable amount.
O. S. 1.20%.

Corrected, his right divergent strabismus was the same as without lenses. Pupillary reaction to light normal O. U. The following treatment was instituted:

Same as in Case No. 1 for one week. Second week reflex drawing technique with CorrectEYEgraphs. (One very peculiar detail I would mention here. The image formed by the diverging amblyopic eye was fairly accurate from the start as to detail but only about two-thirds (⅔) the size of the original as seen by the "good" eye. As the treatments were continued and the vision improved, the drawings were done with increasing exactness of detail and with an increasing likeness of size.)

Re-examination following second week's treatment.

Visual acuity O. D. 90% with correction. O. S. 120% with correction.

He now showed a right exotropia of 3 mm. He was next furnished with hand stereoscope, with cards for home work.

Because of cold contracted by patient, no office treatments given for two weeks, but home work was continued.

Re-examination at end of this period—O. D. 120%. O. S. 120%. Eyes cosmetically straight. 3Δ exophoria at infinity. Following this his home work continued daily for two weeks, check-up then showing orthophoria.

Patient continuing home use of Keystone View Co. photographic stereoscopic views to stimulate rather weak sense of stereoscopic vision, and he is now reporting monthly for observation.

Like other practitioners who have investigated ways and means of correcting amblyopia, I have found it is necessary to "tease the amblyopic eye to see." Of course, in a technical sense, the eye does not see, but as stated earlier in this paper, I am avoiding the highly technical in favor of the practical.

For a number of years, I prescribed the common black rubber snap-on blinder to be worn daily, but have abandoned this technique of total occlusion and have been using, with a far greater degree of satisfaction, a ruby filter made on the same design as the rubber blinder. The ruby filter permits enough vision so that alternating suppression is not encouraged to develop. This latter condition is likely to result in amblyopic cases where a squint exists. An added incentive to fusion is present when both eyes are permitted to be used at once. The results of my experimenting coincide with those reported by Peckham.

I have had very satisfactory results by furnishing these young patients with red and white beads, exactly alike except for color, and having the child string these beads in alternate colors while wearing the ruby filter before the better eye. It is a conceded fact that any method which stimulates both the sight centers and the motor centers will secure quicker results and this principle can be utilized in numerous ways. I have had excellent results with the ball-in-cup game. This is a wooden cup on the end of a stick about a foot long, a wooden ball an inch in diameter, attached by a string to the handle. The trick is to swing the ball upward and catch it in the cup. I obtained a number of these and painted the balls a brilliant red and had young

patients play this game while wearing the ruby filter. This is a strong incentive to use the amblyopic eye. The toy counter of the five and ten cent store will furnish many variations. Any toy which has moving parts of red or which can be painted red will hold the interest of children and gain their co-operation. We all know this co-operation is essential to success. Most children like to draw. All five and ten cent stores carry drawing books with outline drawings. I furnish these books and have children fill in the outlines with red pencils, the ruby filter being worn.

The light intensity should be reduced for the better eye below that registered by the amblyopic eye. The patient should report that "the light seems brighter" before the amblyopic eye. This result can be obtained by Ryers' suggestion of adding a smoke filter to the ruby.

Several years ago, I designed a luminous stereoscope arranged to flash. This was made for me by the American Optical Company. In this instrument, it was possible to control the illumination of each picture separately. I have used this with considerable success. Recently, a somewhat similar instrument has been offered the profession.

Cameron's Myologic Unit is equipped with a revolving cone in the larger end of which is placed a translucent chart with various sized words behind which is a light flashing on and off as the cone revolves.

The Telebinocular made by Keystone View Company, makes use of specially designed charts to be traced by the amblyopic eye and the American Optical Company has recently brought out the Cheiroscope, developed by Maddox, of England. Both of these instruments utilize the same basic principles and follow the same essential steps, namely:

1. To restore vision in the amblyopic eye.
2. To link together in the visual brain centers corresponding retinal points.
3. To build up the fusional urge and fusional reserves.

The old familiar drawback to home treatment was the difficulty with which we were able to get the co-operation of the patient and the impossibility of telling whether or not the patient was actually following instructions. By means of the Keystone CorrectEYEgraphs, it is now possible to require the home work to be turned in for inspection and filing as part of the case record.

The Telebinocular, like the Cheiroscope, can be used to develop co-ordination between hand and eye which greatly quickens the desire of the eye for vision by what we call the Reflex method. A CorrectEYEgraph is placed in the instrument with the picture or geometric design before the normal eye, this image is projected by the normal eye through the chiasm and by reflex action is projected through the amblyopic eye as though seen by the amblyopic eye. Its image will be seen as clearly as though it received the impression direct. A pencil is held in the hand and the picture which is apparently seen by the amblyopic is traced. This technique can be enlarged still further by having the patient fill in, in colors any part of the drawing desired.

Each CorrectEYEgraph is calibrated with a metric scale showing the actual fusion distance and any deviation from the normal. These graphs are sufficiently intricate so that it is impossible for patient to receive the impression through the dominant eye and then from memory copy it by using the amblyopic eye. Pictures must be traced, not copied. Copying tends to alternate monocular vision. Tracing stimulates binocular vision. Tracing requires co-ordination.

The ingenious optometrist will delight in exploring this almost virgin field and will, as he proceeds, develop a technique all his own. I know of no other phase of optometry which rewards the practitioner with a feeling of something tangible accomplished as does the awakening of vision in the amblyopic eye.

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A CASE OF FUNCTIONAL BILATERAL PTOSIS*

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History. Dr. T. F. H., age 45. A well known surgeon, graduate of the University of Minnesota, practicing in a town in the southern part of Minnesota, was sent to me by another medical practitioner for an examination on October 4th, 1930.

When the patient walked into the office he walked erect and threw his head back, in order to be able to see to walk. He gave me the following history: On Saturday, October 26, 1929, he attended a football game at the University of Minnesota at Minneapolis. In the evening when he drove home, a distance of about 100 miles, there was a considerable amount of travel on the road and in consequence an unusal amount of glare, which annoyed him very much. When he came home, he had a headache all of that night, and on Sunday morning the right eye was nearly closed; the next day the right eye was completely closed, and the left eye also began to close. On the fourth day the right eye remained completely closed and the left eye was about 80% closed. He called on Dr. R., a local ophthalmologist. After examination, Dr. R. suggested a rest for a couple weeks, and everything would probably come out all right. Dr. H. followed this advice, and at the end of that period there was no particular change to be noticed. He then came to Minneapolis and was examined by a prominent ophthalmologist who prescribed two pairs of glasses for him. These were, of course, of little help in view of the fact that his eyes were closed. During the next 12 months he was examined by a number of ophthalmologists and optometrists, in most cases, nothing was done for him, and in a few instances glasses were prescribed. Toward the end of that period, he was examined at one of the leading clinics in the country, and after a complete and exhaustive examination and study of his case, he was told that all of the findings were negative except a possible peripheral involvement of the third nerve and that not much can be done for his eyes.

When this prognosis was given him at that clinic, he began to get

*An abridgement of the material presented before the American Academy of Optometry at Chicago, December 18, 1932.

discouraged because he was out of practice for a year, and there was no prospect of his being able to practice again in the future.

Examination.

When the lids were pulled apart the eyes looked normal externally, ophthalmoscopic examination was negative, also the pupillary reaction to light and accommodation was normal. His visual acuity without lenses was O. D. 20/50, O. S. 20/20. The last correction given to him under cycloplegic by an ophthalmologist was:

O. D. + 25 D. Sph. ⊃ — 1.00 D. Cyl. Axis 45
O. S. + 25 D. Sph. ⊃ — 1.50 D. Cyl. Axis 90

My examination revealed:

Static retinoscopy:

O. D. + .75 D. Cyl. Axis 160
O. S. + .75 D. Cyl. Axis 180

Dynamic retinoscopy:

O. D. + 2.00 D. Sph. ⊃ + 1.00 D. Cyl. Axis 160
O. S. + 1.50 D. Sph. ⊃ + 1.50 D. Cyl. Axis 180

While there was some difference in the refractive findings, I did not think this to be the seat of the trouble and even if it were, to prescribe new lens, would be of no value as long as his eyes remain closed. After studying his case for a while, I concluded that this must be a case of *functional paralysis* of some of the branches of the third nerve, which in turn affected the levator palpebrarum muscles of each eye, and that excessive glare was probably the immediate cause. If that was correct then our problem is one of regeneration of both nerve and muscle. At first I was inclined to give him the same prognosis he was given by others during the last year. However, Dr. H. insisted that I try to do something for him. "No one else has even tried to do anything for me," said Dr. H. After some further study of his case, I decided to try and treat him with auto-condensation current for 30 minutes daily and this to be followed up with Superimposed Sine wave for about five minutes. This I explained to him may help, at least it is worth trying, as it certainly can not make matters worse. I explained to him the technique thoroughly and taught him how to apply it, and told him that he can go home and have his office associate give the treatments as outlined and come in to see me once every two weeks. He asked me to give him a copy of my book, "The Principles and Practice of Ocular Physical Therapy," as he wanted to study up more on the subject, and of course he was provided with a copy.

After applying the auto-condensation and sinusoidal treatments for about ten days Dr. H. came to my office all excited, telling me that his left eye is opening up. I could not notice any change in his condition, however, I said nothing to him: he was happy, and I wanted him to enjoy it while that state of elation lasted. I advised him to change over from auto-condensation to diathermy current. He followed my instructions, and in three days later he informed me that since changing

the technique a definite retardation of progress was noticeable. I then advised him to go back to the auto-condensation. We should bear in mind that this last named current has the physiological property of stimulation and diathermy is a relaxing current. In his case what we needed is a stimulating current and as soon as a relaxing current was used he immediately noticed the difference.

On October 24, 1930, a few days after he changed back to the auto-condensation technique, I received the following report from him:

"In order to give you an idea as to my progress, I wish to make this a report of the treatment used and of the progress made since my last letter, at which time I felt that I very convincingly noticed a depression and retardation of progress while using the tesla diathermic electric current.

"The progress has been very favorable and I felt very satisfied. The most marked improvement is in my left eye which is beginning to appear very much like an entire normal eye would look. The right eye during the last five days is beginning to show greater ability of control, better visual acuity, less sensitiveness to light and my idea is that so far definite signs of improvement is noted. Because of the depression occurring following the use of tesla diathermic current, I have hardly ventured to use the diathermic current recommended for me in your last letter. Would you kindly give consideration and advise me at this time what your belief is as to the best current used in view of what explanation I have cited above. I have terminated each diathermic form of treatment with the use of two minutes of negative interrupted sinusoidal and two minutes of superimposed sine. These seem to have produced a satisfactory progress."

He continued the treatments daily and when he called at my office for a re-examination, the first part of November, I was able to notice that there was an improvement in the left eye of about 10% to 15%. He was instructed to continue the treatments daily, using the same technique. On December 16, 1930, we received the following report from him:

"I am personally progressing very nicely and know that I have made some very definite improvement since I saw you last Saturday. Today I experienced the following: I was unable on account of time to take my usual electric treatment this morning. I did take the hypodermic containing the Cortical portion of the Adrenal gland. About one hour after this my eyes, especially the right, began to open without any particular effort. This has continued practically all day. It has really elated me a great deal because it does seem from this that there is probably a great deal to this material. I do feel greatly encouraged and believe that I should keep it up for at least a period of two weeks. I am also going to keep up using the electric because I do feel that there is definite good in the electric treatments as has without doubt been demonstrated in my own case. The matter resolves itself solely now in hastening the full recovery if such is possible to be accomplished. I certainly do feel grateful to you in the bringing about of results from the procedures suggested."

The last part of December, Dr. H. came to the office for a re-examination and the left eye looked at this time about 50% open. He was in a complete state of elation in view of the fact that he was able, on the twenty-first of December, to perform an operation on one of his patients. This was the first operation he performed in fourteen months.

The treatments were continued as before and I checked him over from time to time. During the middle of February the left eye was about 75% open and the right eye was still completely closed, but upon covering up the left eye, it was possible for him to raise the right lid

a very small amount. On March 6th, I received the following report from him:

"Concerning my own case. Last week I was away attending Orthopedic Surgery Clinics at Rochester and therefore had no opportunity to take my electric treatments. This week I note quite definite improvement, as I am continuing the rest period for this week. My reason for these two weeks rest period is, partly because of the recommendation of the physiotherapy department at Rochester, that after a period of treatments, a rest period is indicated and the progress is usually more favorable. I will try to see you some time the middle of March."

On April 15th, 1931, I examined him again and I found the left open and normal. The right was about 25% open. I called in my associate, Dr. Koch, and again showed him the case, and in view of the fact that he had not seen it since the first time, before the treatments were started, he immediately noticed the marked improvement.

On June 3rd, 1931, left eye normal, right eye open 50%. On August 15th of the same year both eyes are open wide as any normal pair of eyes.

During the spring months Dr. H. was ordered from the Medical Clinic to which I referred to earlier in this report, to try and use a certain drug—ephendrin—I believe is the name of it. Claims were made in the recommendation that this drug might help Dr. H. Personally I preferred that he should not use anything else besides the physical therapy treatment, because by adding a new therapy it would not be possible to tell which one was responsible for completing the cure. It is to be remembered that at that time his left eye was already normal and the right eye about 25% open. However, Dr. H. felt that he had this condition of ptosis for nearly eighteen months and if there is anything which may hasten complete recovery he would like to take advantage of it. We then decided that he begin using the drug. So from this point on it is difficult to tell whether the drug or the physical therapy is to be given the credit for completing the recovery of the right eye which was already well on the way at that time.

Since I figured out the technique to be used in this case and I have seen it through practically from complete ptosis to complete recovery I was extremely interested to have these results explained from a physiological and a neurological standpoint, in the hope that we may have some definite basis to work upon in the future. I had considerable discussion regarding this with one professor of the medical school in the physiology department and he could not throw any light on the subject, although he was very much interested in the results accomplished. He did, however, claim that it is possible that Dr. H. might have had his eyes return to normal even if none of the treatments were applied. To this, I hardly agree, because according to authorities on nerve regeneration, if a nerve will regenerate, there will be partial regeneration in six months and complete regeneration in 18 to 24 months. In this case of Dr. H. there was no improvement at all noticed for 14 months and as he began to apply the physical therapy technique mentioned in the earlier portion of this report, there was a marked improvement after two or three weeks' treatment.

I also discussed this case at some length with the dean of the medical school and while he was extremely interested and pleased to learn of the results, he could not throw any more light on the subject, other then to congratulate me, suggesting that I have these results published and also advised that I use the same technique on some other case of ptosis in the future.

My personal interpretation of this case and how the results were accomplished is this: Dr. H., driving home that night, met many automobiles with glaring lights which annoyed him very much. This was the immediate cause which brought on the ptosis. There may have been some other physiological factors present, previously, which were the major cause, and the annoyance of glare, while driving home that night, merely acted as the trigger to bring about suddenly this condition of ptosis.

There are two lines of evidence which tend to prove clearly that our original hypothetical diagnosis that this was a case of ptosis due to functional paralysis is correct

(1) Dr. H. had a number of ocular examinations made by a number of ophthalmologists and they found no pathology. He also had a most thorough examination, both physical and ocular, at one of the leading medical clinics in the country and there again all the findings were negative.

(2) Professor J. J. B. Morgan and other authorities on functional abnormalities give the following points of differential diagnosis between functional and pathological defects:
   (a) The onset is sudden and unusual in functional cases.
   (b) The recovery is sudden.
   (c) The reflexes are normal.
   (d) The patient may even use the affected organ.

   Any one or all of these signs may be present in any functional case.

Now let us see what we find in the case of Dr. H.:

(a) We find that the onset was sudden.

(b) Recovery was sudden. He began to feel improvement within a few days after the treatments were applied.

(c) The reflexes were normal. Here we have three out of the four points of the differential diagnosis signs present.

The evidence present points definitely to the fact that this was a case of functional paralysis.

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RESULTS OF MEDICAL TREATMENT IN CATARACT CASES*

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In 1932 Frank E. Bateman, A.B., M.D., treated a case of post-papillitic atrophy of the optic nerve with a series of medicines administered internally over a period of nine months and succeeded in improving vision from O. D. light perception, O. S. 10/200, to O. D. good light perception, O. S. 20/20. Dr. Bateman applied the same general sort of medication to other cases of low vision which he encountered in his general practice and obtained improvement in acuity in many of them. During the next few years he treated several cataract cases in this way and improved visual acuity resulted in a number of them. About this time the writer became interested in Dr. Bateman's work and thenceforth made careful monthly eye examinations of all of his own and Dr. Bateman's cases that presented cataract in either or both eyes and the internal medication was administered by Dr. Bateman. In addition to the treatment for cataract, such other medicines were employed as were required to overcome such physical ills as were present in each individual case. The results were satisfactory in many instances and the method of treatment, together with a study of several cases was reported in a recent issue of the Eye, Ear, Nose and Throat Monthly.[1] Briefly stated, the treatment consists of a nucleus of easily obtained medicines with such other medication as may be necessary for the well being of the individual patient. The dosage of the fundamental medicines is changed from time to time as the condition of the patient requires.[2]

Improvement in cataracts appears to occur in proportion to the improvement in the physical condition, which emphasizes the importance of treating the whole patient rather than confining the medication to a single part. This is quite in line with the conception that cataract is a local manifestation of a general process of sclerosis. Although the funda-

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*Submitted for publication April 22, 1934.

[1]The Value of Internal Medication in the Treatment of Cataract. Bateman, Frank Elliott, and Eames, Thomas Harrison, Eye, Ear, Nose and Throat Monthly, December, 1933.

[2]The medicines and dosages are enumerated and discussed in the article referred to in footnote 1.

mental method is approximately the same in all cases the necessity of studying each individual patient and adjusting the medical treatment to his particular needs is of very great importance, particularly as there are no two cases alike in all respects. Some patients require much larger doses than do others in order to bring about the desired therapeutic effect.

Best response to treatment has been made by patients with senile cataracts of recent formation. The prognosis is good in those presenting fina cortical striae, fine cortical speckling, etc., with a clear view of the fundus obtainable between the opacities. The prognosis for vision is fair when the lens is generally, though lightly covered over with striae and punctiform opacities so arranged as to give the impression of dust particles held in a film of oil on a glass. When the three lens segments are heavily outlined with opacities in the amorphous substance of the septa the possibility of entire resorption of these "lines" is poor, but vision may be improved if the lenticular tissue is not too extensively involved between the segments. When a heavy peripheral cataract is present with a central or lateral clear area through which a fairly good view of the fundus can be obtained, usable vision up to 20/40 or slightly more is possible. The prognosis is poor when the lens is uniformly gray and densely involved, vision being restricted to less than 20/20. The chances are not good when droplets are seen in the lens or when its surface is dotted with gray nodules. Nuclear opacities are very obstinate. In a few cases presenting very heavy opacities in the lens substance rather unlooked for improvement in the tissues and in vision has followed treatment, but notwithstanding this it is wise not to expect too much when the acuity of vision is below 20/200.

In the majority of cases seen here the opaque tissue has appeared to have originated on the edge of the lower temporal quadrant of the lens and to have spread peripherally toward the upper nasal quadrant, which is the last portion to become involved and the first to clear when resorption takes place. Resorption first appears in this area as a thinning which is manifest by increased brilliance of the retinal reflect in ophthalmoscopy. Later the retinal vessels can be made out dimly through the clearing area and finally the retina can be seen clearly if resorption progresses far enough. In the milder cases presenting clear areas with dense punctiform or rod-like opacities scattered through the lens or on its surface, resorption shows itself in a reduction in size of the opaque area or figures. These finally become very faint in successful cases. The punctiform opacities when small and not associated with the nuclei of the lenses are most likely to disappear; the rod-like ones usually leaving a hair line or scratch-like remnant. Remains of the hyaloid artery should not be mistaken for cataract. Although few cases of persistent hyaloid artery have been seen it is believed that treatment will not affect opacities of this nature. Some patients under medical treatment for cataract present changes in refractive error, usually in the nature of a slight reduction in hypermetropia. This is regarded as favorable, but should a gross change of this kind occur in a case *not* receiving the medication it would indicate

the onset of degenerative lenticular changes and the prognosis for vision would be grave. Such a person should be referred to the general practitioner for careful physical examination and such treatment as may be necessary.

Retinal function tests should be carried out before referring cataract cases for treatment or operation. It occasionally happens that cataractous changes mask the presence of optic nerve, choroidal, and retinal pathologies which would prevent improvement in vision if the lens were cleared partially or completely. Such cases, of course, present a difficult problem, and it is wise not to encourage the patient too much with hopes of improvement if retinal function tests are productive of questionable or poor results.

The accompanying table presents visual improvement in a representative group of cases. It is particularly notable that improvement measurable by the relatively crude Snellen Chart occurred in between 65% and 70% of the cases. Visual improvement seldom exceeds two lines on the Snellen Chart. This is partly due to the fact that many cases are put under treatment as soon as lenticular opacities are detected and before vision has been very much impaired; and partly due to the fact that the amount of improvement is inversely proportional to the degree of involvement of the lens tissues. Although the table lists improvement as line increment and groups cases with visual acuity below 20/200 as in the O class, improvement in gross vision from light to 10/200 or from 10/200 to 20/200 is not uncommon. If counted in the improvement classifications such cases would undoubtedly increase the percentage of cases showing improvement.

Table.

Improvement in vision in terms of lines on the Snellen Chart.

No. of lines	Percentage of right eyes	Percentage of left eyes
2 or more	42.3%	30.7%
1	23.0%	38.4%
O or less than one line	34.6%	30.5%

Average time under treatment: 7.4 months.
Median age: 68 years, 3 months.
Number of cases: 26.

The duration of treatment in the group reported here averaged 7.4 months, while that of the group reported by Dr. Bateman and myself averaged 7.0 months. The usual procedure in the management of the cataract cases is as follows: The patient's eyes are examined by the writer. Visual acuity is noted; retinal function tests are made; the patient is refracted if the cataract is not too extensive, and tests of coordination and fusion are employed when possible. Ophthalmoscopic examination follows and drawings are made of the opacities in each lens. The lens is considered in quadrants rather than in thirds so as to facilitate the identification of the various opacities. The antero-posterior placement of the occluding opaque tissues in the lens substance is estimated. The fundus is

examined as extensively as the cataract will permit and all abnormalities are recorded. The patient then undergoes a general physical examination by Dr. Bateman, who makes a study of the general condition in relation to the eye pathology. A conference on the findings follows and then the treatment is prescribed. A certain amount of change in the refractive condition is expected so that glasses are not often changed at first unless the ones used by the patient are quite markedly unsuitable. When the maximum improvement in vision and in the tissues has been made the glasses are changed if the refractive condition is such as to make this necessary. The medical treatment is prescribed by Dr. Bateman with both the cataract and the general condition in mind. The fundamental medicines employed are modified or augmented by others as the individual case requires and these are discussed in the joint report by Bateman and Eames referred to in footnote 1. At the end of the first month most patients report that they feel better physically, and some notice improvement in vision. We do not expect measurable improvement in visual acuity until the end of the second month.

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OPTOMETRIC EDUCATION AND RESEARCH

To give professional recognition to any group—These three important prerequisites are to be fulfilled: (1) Undergraduate education, (2) Graduate study, (3) Research.

During the last decade considerable headway has been made in the fields of optometric undergraduate education. The different optometry schools have expanded their curriculum so that today the young men and women who graduate from any Class A Optometry School are on a par, from the standpoint of technical preparation, with students of any other professional school. The trend of late years has been to have students spend some time in preprofessional academic study. For instance, medicine, dentistry and law require one to two years study of the general sciences before the students are enrolled in the professional course. We are informed that the Pennsylvania College of Optometry is adding one year to its curriculum for preprofessional studies, other schools will unquestionably follow suit. We thus see that our educational facilities for the undergraduate study compares very favorably with those of other professions.

During the last few years a considerable desire for graduate study has developed amongst the rank and file of optometrists. This is the

result of the work done by the American Academy of Optometry, various technical publications and the graduate study movement. While the quest for graduate study is now at its highest point it is regrettable to state that there is no adequate agency in the field at the present time to supply the demand. To be sure there is some effort made in a few instances to meet the demand. For instance, during the month of June a very fine one week graduate course is offered the profession by the Pennsylvania College of Optometry. But this is not sufficient to meet the universal demand for graduate study and attempts are being made by certain private individuals to capitalize upon the present situation, with the result that we find that they frequently substitute salesmanship and showmanship in place of science, and politics in place of principles. If this movement for graduate study is not to collapse and complete apathy take its place, it is important that a commission of educators be appointed to develop a sound plan for graduate study which will really teach the members of the profession something of the accepted principles and facts and at the same time place graduate study on a financial basis which will be within the reach of all.

If we look at the field of Optometric Research we find that organized optometry has neglected this field even more than the field of graduate study. To be sure the American Academy of Optometry through its members carry on some research, but the amount an organization of this size can accomplish is at best limited.

The editors of this Journal therefore recommend to the American Optometric Association the consideration of these problems: (a) Graduate Education and (b) Optometric Research and suggest that a commission of educators and research men of national standing be created to lay plans for a system of graduate education and research.

It is a matter which should be handled by our large National Society and it is one that could be easily financed when placed in the hands of men capable of directing these types of activities. Optometrists have shown themselves willing to gather and study. Wholesome opportunities should be provided.

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OCULAR SYMPTOMS IN GENERAL PATHOLOGY

A knowledge and recognition of ocular symptoms which are caused by general disease is of importance to optometrists. While he may not treat these cases himself, he will, when equipped with such a knowledge of symptomatology be in a position to recognize some of the difficult cases and will be able to refer his patient to the proper medical practitioner for treatment. Gjessing[1] discussing this subject claims that it must be evident that the pathology of the central nervous system is rich in eye

[1]Gjessing, H. G. A. British Medical Journal. March 31, 1934.

symptoms. This is demonstrated by the transient paresis of the eye muscles in tabes, lues cerebri, encephalitis and disseminated sclerosis. One of the chief symptoms of disseminated sclerosis is acute scotomatous retrobulbar neuritis which Traquair characterises as commencing quickly, having a changing tendency during its run and ending almost in complete cure. It is, however, liable to return. This neuritis is usually monocular and may make its appearance many years before the other symptoms of disseminated sclerosis. The scotoma in this neuritis is always central and it differs from the intoxication amblyopias where the scotomata always commence paracentrally.

In a number of acute toxaemias in febrile diseases there may be paralysis of the pupil. Especially well known is the post-diphtheritic paralysis of accommodation. After an influenza the same occurs, but not so commonly. Both conditions give rise to a bilateral palsy. Cyclitis is not infrequently observed after influenza. Conjunctivitis is a most important diagnostic feature in measles and may be the first prodromal symptom.

It is well known, continues Gjessing, that diabetes mellitus may often be accompanied by changes of refraction. Every sixth diabetic has, as a rule, eye complications. Generally speaking, chemical alterations of the blood may be followed by eye symptoms, and many cases of chronic conjunctivitis resist treatment until the patient has been given a tonic.

It is held by some authorities that glaucoma may be caused by the blood condition known as hyperiodaemia, and in such cases care should be taken in the use of iodides, thyroid extract or other hormone preparations for the treatment of hypertonia arteriosclerosis. On the other hand, some authorities contend that all patients suffering from glaucoma have diseased blood vessels (disturbed capillary circuit).

Quite a number of retinal diseases are also due to general disease, especially disease which affects the blood. Pernicious anaemia is the typical blood disease generally associated with retinal alterations, in contrast to the secondary anaemias which almost never lead to retinal disturbances. At the peak of pernicious anaemia retinal hemorrhages are always present.

Two very common diseases in which the finding of retinal hemorrhages and exudative spots is of the greatest importance are nephritis and diabetes.

Nystagmus is one of the cardinal symptoms of disseminated sclerosis, but it is frequently present in healthy persons when looking extemely sideways. Miners' nystagmus is due to bad hygienic conditions in coal mines, and in this connection Percival's statement regarding blue-blindness preceding the nystagmus is of utmost significance. Shock has been known to release a latent nystagmus, and certain poisons (iodoform and morphine) may also produce oscillations.

Poisoning due to santonin and digitalis often brings on exanthopsia, hallucinations and red vision. Acute poisoning from methyl alcohol is

accompanied by a rapidly developing amaurosis resulting from an acute degeneration of the ganglion cells of the retina. Secondary atrophy of the optic nerve is also observed. The extrinsic ocular muscles are, however, unaffected, and in this respect this poisoning differs from the similar picture in meat poisoning.

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ON THE EFFECT OF LIGHT WHICH ENTERS THE EYE

Psychology has not as yet discovered all of the effects of spectroband light upon human behavior. But we do know this, that the pleasure people take in color and light, just like the pleasure in music, has its physiological equivalent in some sort of stimulation of the vital functions by the cells of sight in the brain. We know that some people will sneeze when they are suddenly exposed to sunlight. This would tend to indicate that some reflex stimulation of the respiratory centers takes place. Indeed, it is claimed that it has been proved that exposure of the eyes to sunlight is followed by increase in the respiratory quotient. When a magnesium light is flashed before the eye, it is not only followed by a twitch of the eyelid, but also by contraction of other muscles, and other associated functions are probably stimulated. We know that afferent impulses are usually followed by efferent, and we most certainly would expect that the optic nerve, being so large, and having so many of its fibers connected with different brain centers, and causing so much cerebral activity, has also different reflex connections.

R. C. Macfie claims that it is probable that all molecular changes due to light in the optic nerve tracts have not only visual and psychological significance, but also specific influence on the functions and metabolism of the body. It has been proved that light received through the eye increases the elimination of carbon dioxide and the intake of oxygen. It is difficult to believe that a receptor specially adopted to receive and transform light rays should not have a physiological as well as a psychical function. J. I. K.

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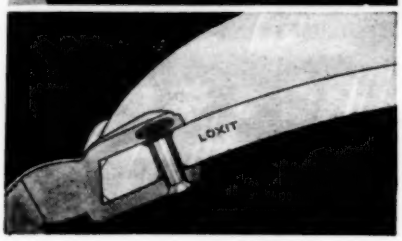

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